Revista de Investigação Pesqueira
Maputo No. 21 (1992):50-58

Preliminary Estimation of Growth in *Cheimerius nufar* (Sparidae) from Southern Mozambique

by

IVAN G. TIMOCHIN

ABSTRACT

On the basis of length-frequency data collected in 1987, by the hook-and-line fishery research program, preliminary estimates of the parameters of a seasonally oscillating version of the von Bertalanffy equation for *Cheimerius nufar* (Ehrenberg, 1830) were obtained, i.e., $TL_{\infty} = 70$ cm and $K = 0.17$ year^{-1}. A discussion of these results is provided.

RESUMO

Com base nos dados de distribuição de frequências de comprimentos, colhidos em 1987 no programa de pesca à linha, foram obtidas estimativas preliminares dos parametros de crescimento da equação de von Bertalanffy de crescimento, de *Cheimerius nufar* (Ehrenberg, 1830), ou seja, $TL_{\infty} = 70$ cm e $K = 0,17$ ano^{-1}. Apresenta-se uma discussao sobre os resultados obtidos.

INTRODUCTION

The main fishing grounds for national and foreign industrial trawlers off Mozambique are Sofala and Boa Paz Banks, where several resources of crustaceans and fish are exploited. These fisheries are reasonably well documented (see, e.g., contributions in vol. 9 of Revista de Investigação Pesqueira, 1984).

Representatives of the families Sparidae, Lethrinidae, Serranidae, etc., which inhabit the untrawlable areas of Sofala Bank and Boa Paz are, on the other hand, exploited by artisanal and semi-industrial vessels. In our opinion, these fish resources are presently underutilized. Little is known about the species composition of the catches on those grounds, on areas of major concentrations, and on the biology of the main species.

There are reports showing that this type of fishery is quite developed on the coast of South Africa; in some cases the level of effort applied to these resources reaches (or surpasses) that corresponding to maximum sustainable yield (Garratt, 1984, 1985, 1986; Garratt & Van der Elst, 1987; Denton & Van der Elst, 1986).

The Instituto de Investigação Pesqueira (IIP) launched, in 1987, a research program on the hook-and-line fishery on the southern Mozambican waters. The area considered is located between latitudes 24°10'S and 26°20'S (Fig. 1), and includes inshore waters 15 to 80 m deep.

Data were collected from two boats belonging to the state company SULPESCA: "CHAI-I" (LOA = 14 m) and "INHASSORO" (LOA = 16 m). They operate using hand-lines consisting of lines of 0.35 to 0.45 mm in diameter with 3-4 hooks each.

A preliminary report was recently prepared which describes this fishery and its yield in recent years (Timochin, 1988). In 1987, total catch amounted to over 58 tonnes, which does not reflect the real potential of the the stock, because the boats' operation, for several reasons, was not continuous over the whole year.

Besides the SULPESCA boats, line fishing is also practised by private owned boats and by artisanal fishers, but IIP does not have reliable information on these yet.

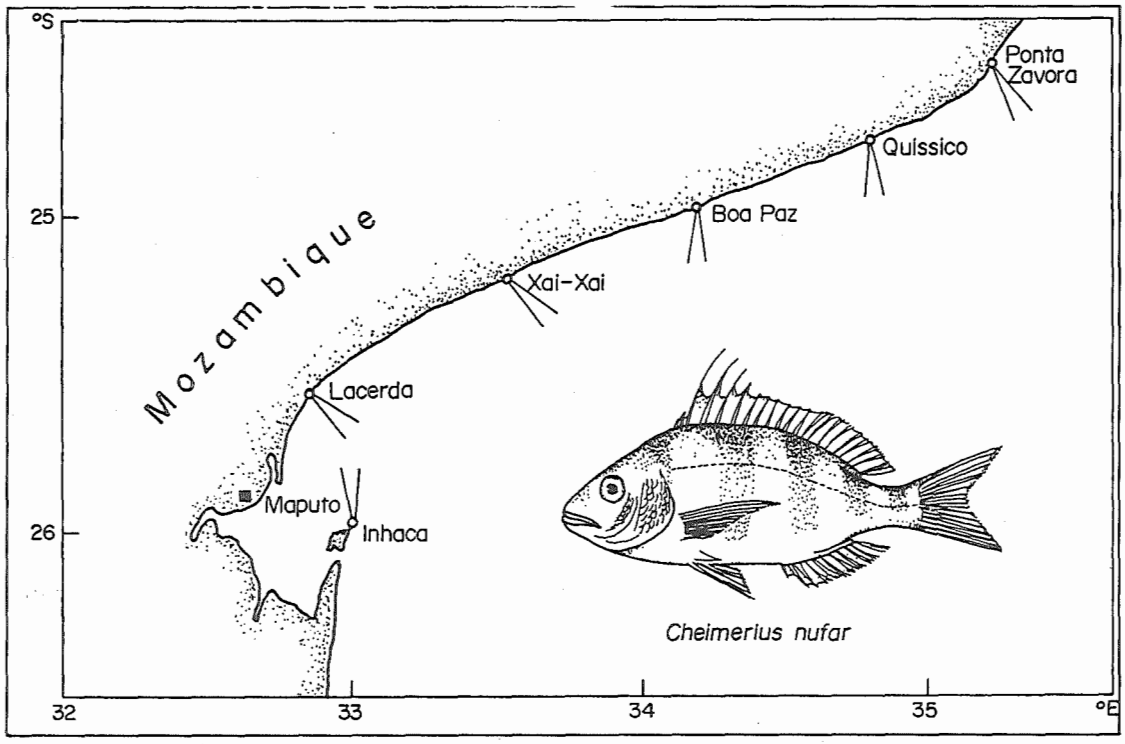

Fig. 1. Map of southern Mozambique, showing positions of the lighthouses that provide the name of the different fishing grounds of the hand-line fishery.

In the present study an attempt was made to estimate the growth parameters of santer seabream *Cheimerius nufar* (Fam: Sparidae), one of the important species of the above mentioned fishery, based on data collected in 1987.

MATERIALS AND METHODS

From March to December 1987, the landings of the fishing vessels "CHAI-I" and "INHASSORO" were inspected in order to determine the species composition of the catch and to perform measurements and biological analyses of the most abundant target species. For all the fish analyzed, three measurements were taken: standard length, fork length ("Smith's length" in Russian) and total length, to the cm below.

Individual total length measurements of *C. nufar* were grouped in 2-cm classes (Table 1). Further processing and analyses were performed using the Compleat ELEFAN software package (Pauly, this vol.). For determination of the growth parameters of *C. nufar*, the data were regrouped into 10 samples, representing one month each (see Table 2).

Table 1. Original sample of *Cheimerius nufar* from southern Mozambique.

Date	Boat	Total length (2-cm class mark)																					
		21	23	25	27	29	31	33	35	37	39	41	43	44	45	49	51	53	55	57	59	61	sum
13/3/87	CHAI-I			2	6	4	12	10	7	17	6	9	7	8	2	4					1		95
6/4/87	CHAI-I			2	2	4	10	11	16	9	13	8	8	2	3	2			1				91
13/4/87	CHAI-I				4	1	6	10	13	15	10	7	10	8	4	2	1						91
23/4/87	INHASSORO	1		1	1	1	2	4	3	6	4	2	1	1	1	2							29
23/4/87	CHAI-I			1	5	2	4	5	8	9	6	3	1	3	0								47
30/4/87	INHASSORO			1	1	1	2	2	4	2	7	3	4	5	4	4	2	1		2			45
30/4/87	CHAI-I			1	6	7	1	8	9	7	8	10	10	4	3								74
11/5/87	INHASSORO			1	2	3	1	7	5	9	7	3	10	5	4	3							60
16/5/87	CHAI-I					1	6	6	7	11	19	17	16	7	4	5				1			100
19/5/87	INHASSORO			2	3		4	5	8	7	11	3	3	1									47
26/5/87	CHAI-I				2	1	1	4	8	10	9	8	10	9	3	1							66
2/6/87	CHAI-I				3	3	2	3	9	9	2	2	8	12	2	3	1						59
17/6/87	INHASSORO					2	1	2	3	7	8	5	2	5	6	5	2		1		1	1	51
18/6/87	CHAI-I			1	2	3	5	11	13	10	8	11	10	5	1		1						81
15/7/87	INHASSORO			2	8	17	18	14	11	8	11	3	2										94
30/7/87	CHAI-I				5	7	3	5	10	8	13	11	6	1	6	1	1						77
3/8/87	CHAI-I		1	1	6	14	11	17	6	12	10	7	9	4	4					1	1		104
5/8/87	INHASSORO				8	9	9	5	10	13	11	14	13	3	4	1	1		3				104
6/8/87	CHAI-I				2	3	7	1	4	8	5	4		2	4		1		1		1		43
25/8/87	INHASSORO								1	1	1					1	1						5
9/9/87	CHAI-I			1	2	4	4	4	8	10	3	7	10	6	1								60
10/10/87	CHAI-I			1	3	2	7	11	10	2	5	9	2	1									53
20/10/87	CHAI-I		1		4	12	10	12	3	10	9	7	3	4	1	4							80
27/10/87	INHASSORO					4		1		3		1		1									10
4/11/87	INHASSORO		2			1	2		3		2	4	2	2	2		1		1				22
11/11/87	CHAI-I		1		8	11	5	9	14	7	14	4	9	4	9	2							97
13/11/87	INHASSORO				3	1	3	2	1	2	4	3	8	3	2								32
20/11/87	INHASSORO				5	11	3	5	5	6	6	3	6	1	1								52
5/12/87	INHASSORO	1		2	2	1	2		17	2	5	2	1										26
5/12/87	CHAI-I		2	1	4	6	10	6	14	5	9	7	2		1								67
14/12/87	CHAI-I	1		2	11	6	8	6	8	5	5	5	1	5	2								65
21/12/87	CHAI-I		1	6	10	15	12	11	13	5	7	8	6	1	2	2	2					1	102

Table 2. "Artificial year" constructed with the pooled samples of *C. nufar* from southern Mozambique, 1987 (TL, cm).

ML/DATE cm	March 3	April 23	May 18	June 14	July 23	Aug. 10	Sept. 9	Oct. 22	Nov. 12	Dec. 9
21		0.34								7.72
23		0.00				0.06		0.10	13.24	0.66
25	22.06	1.51	0.45	0.11	12.86	0.06	7.07	0.21	0.00	19.12
27	66.17	13.58	2.04	2.26	121.32	14.51	14.14	3.86	97.99	44.20
29	44.11	10.36	0.75	37.69	207.14	26.90	28.28	327.91	150.54	38.76
31	132.34	21.86	7.05	21.68	157.67	28.08	28.28	22.65	63.16	51.86
33	110.28	47.11	14.74	53.41	159.90	20.42	28.28	119.65	107.38	29.11
35	77.20	81.78	28.95	91.26	210.49	26.55	56.56	20.87	166.70	105.39
37	187.48	74.91	49.93	151.15	163.25	51.66	70.70	245.10	87.55	24.51
39	66.17	66.36	84.47	148.74	252.42	35.05	21.21	15.45	171.95	57.22
41	99.25	32.78	56.59	104.53	173.03	41.20	49.49	99.41	58.32	31.52
43	77.20	37.40	66.77	60.98	96.72	36.01	70.70	1.98	133.74	11.60
45	88.22	18.31	26.57	117.99	13.98	3.16	42.42	79.37	46.89	3.69
47	22.06	8.58	5.51	105.16	83.86	5.89	7.07	0.10	105.87	1.14
49	44.11	6.50	4.53	88.59	13.98	4.07		2.09	23.80	0.38
51	0.00	1.12	0.00	35.09	13.98	4.18			0.58	0.38
53	0.00	0.23	0.00	0.00		0.00			0.00	0.00
55	0.00	0.10	0.00	17.38		1.86			0.58	0.00
57	11.03	1.02	0.14	0.00		0.06				0.00
59				17.36		0.17				0.00
61				17.38						0.09

A preliminary estimation of L_∞ and Z/K was done using the modified Wetherall method (Wetherall, 1986; Pauly, 1986). The results, shown in Fig. 2, suggest strong selection against both the smaller and the larger fish. To overcome this problem, further information on *C. nufar* was sought in the available literature, and this information was used to constrain the range within which the search for best growth parameters values was performed.

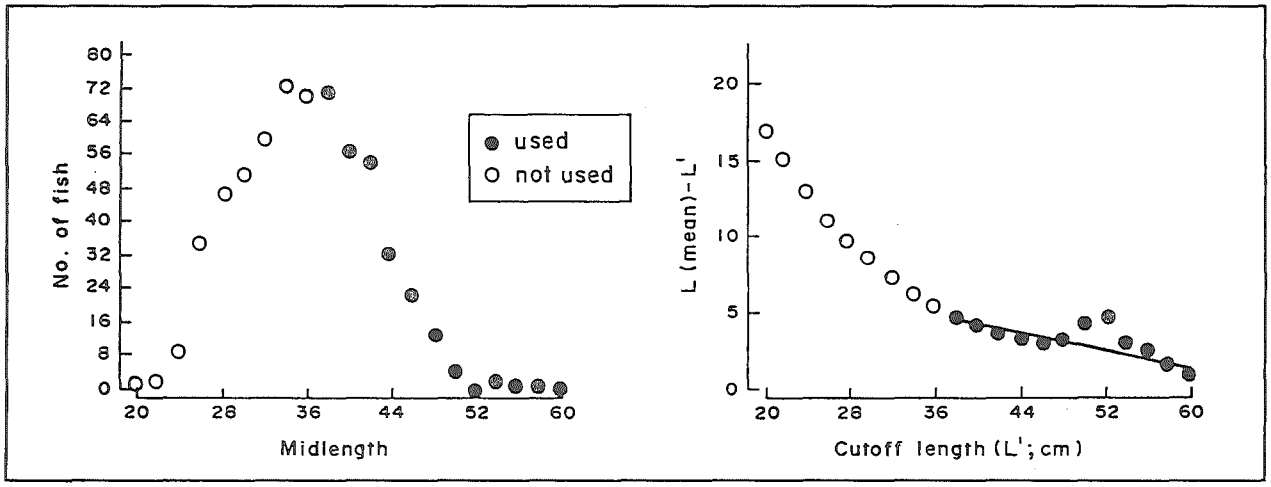

Fig. 2. Modified Wetherall plot of the whole set of C. nufar *length-frequency data, showing the regression line starting at the cut off length of 36 cm. (L_∞= 69.4 cm, Z/K = 4.6).*

RESULTS AND DISCUSSION

Asymptotic length was found, using the Wetherall plot (Fig. 2), m to be about 70 cm. In our samples, the biggest fish measured 62 cm, but it is now clear that selection against the larger fish, which can be expected from hook-and-line fishing, could have prevented bigger fish from being caught.

Fig. 3 presents the key result of this reanalysis, which is based on a fixed value of TL_∞ and which assumes no seasonal growth oscillations (i.e., C=O).

However, Fig. 3 shows a small yet distinct optimum at $K = 0.17\ year^{-1}$, which may represent the value sought here. Indeed, comparisons of the growth performance index computed from $L_\infty = 70$ leads to $\phi' = 2.92$, close to the values of ϕ' estimated for *C. nufar* in the Gulf of Aden (Table 3).

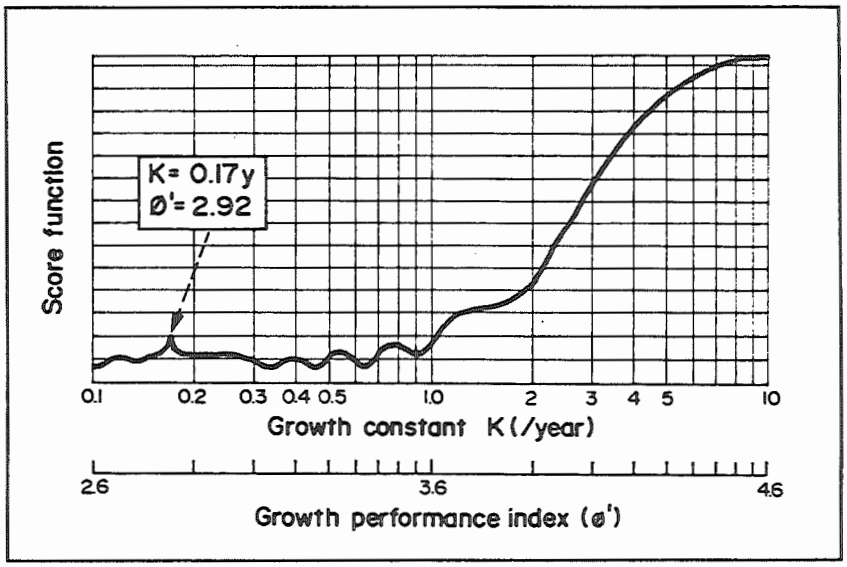

Fig. 3. Facsimile of SLRCA method as implemented in the FiSAT software package. Note that for $L_\infty = 70$ cm, a small peak occurs at $K = 0.17\ year^{-1}$, which corresponds with an acceptable value of ϕ' (see text).

Table 3. Comparison of growth parameter estimates in *Cheimerius nufar* (Sparidae).

Locality	TL_∞ (cm)	K ($year^{-1}$)	ϕ'[a]	Source
Gulf of Aden	100	0.067	2.83	Pauly (1978), based on Druzhinin (1975)
Gulf of Aden	65[b]	0.18	2.88	Edwards et al. (1985)
Mozambique	70	0.17	2.92	This study

[a] $\phi' \log_{10}K + 2\log_{10}L_\infty$ (Pauly & Munro, 1984).
[b] Converted from FL using FL : TL ≈ 1:1.12.

Going further than this, given the lack of representativeness of the data used here would not be useful. Rather, an attempt will made in the future to obtain otoliths of large specimens of *C. nufar*, and to send them for interpretation to a specialist abroad. This, in conjunction with more intensive sampling of the catches, may allow a future assessment of the fishery.

Van der Elst (1981) and Smith & Smith (1986) state that *C. nufar* attains a maximum length of 75 cm; Bauchot & Smith (1984), on the other hand, give for the Western Indian Ocean a value of 60 cm. Garratt (1985) reported a maximum size of *C. nufar* to be of 67 cm in his samples.

Running the ELEFAN I program to find the best combinations of growth parameters led us to the conclusion that L_∞ may be higher than 70 cm. With the available data, however, the best fit was obtained for values close to 70 cm. For subsequent search of the other parameters, this value was thus kept constant.

The growth curve (not shown) derived from the "best" combination of growth parameters had in addition to $L_\infty = 70$ the parameter values: $K = 0.35$ year^{-1}; $C = 0.3$; and $WP = 0.9$. The latter two values would suggest mild seasonal oscillations, and minimum growth rates in November.

However, comparison of these results with the two sets of growth parameter estimates published so far (Pauly, 1978; Edwards et al., 1985) suggest that the value of K estimated by ELEFAN I is too high. This is (indirectly) confirmed by Garratt (1986) who gives a value of $K = 2.2$ year^{-1} as "an average value for several sparids". No indications are given as to the source of this information, which is probably a typographical error, with 0.22 year^{-1} the correct value - much lower than 0.35 year^{-1}.

To follow up on this, the data in Table 1, grouped for the ELEFAN I analysis were reanalyzed using the SRLCA method of Shepherd (1987), as implemented in the FiSAT Software (Pauly & Sparre, 1991); it was hoped that this approach, found by Isaac (1991) to be more accurate than ELEFAN I when applied to long-lived fishes would help resolve the problem, associated with the abovementioned high estimate of K.

ACKNOWLEDGEMENTS

The author wishes to express his gratitude to Dr. D. Pauly and to Rui de Paula e Silva for their help in data processing and their critical observations during the preparation of this paper, and to Mr. Andrei Polyakov for his translation of the original Russian manuscript into English.

REFERENCES

BAUCHOT, M.L. AND M.M. SMITH (1984) - Sparids. *In* W. Fischer and G. Bianchi (eds.) *FAO species identification sheets for fishery purposes*. Western Indian Ocean (Fishing Area 51). Prepared and printed with the support of the Danish International Development Agency (DANIDA). FAO, Rome. Vol. IV: pag. var.

DENTON, N. AND R. VAN DER ELST (1986) - Natal offshore Sciaenidae and Serranidae, pp. 29-33. *In* Report on research during the period April, 1985 to March, 1986. Oceanographic Research Institute, Durban.

DRUZHININ, A.D.; (1975) - Some data on Sparid fishes (Fam.: Sparidae) of the Gulf of Aden Region. J. Ichthyol. 15: 531-541.

EDWARDS, R.R.C., A. BAKHADER AND S. SAHER (1985) - Growth, mortality, age composition and fisheries yield of fish from the Gulf of Aden region. J. Fish Biol. 27: 13-21.

GARRATT, P.A.; (1984) - Natal offshore reef fish, pp. 12-13. *In* Report on research during the period April, 1983 to March, 1984. Oceanographic Research Institute, Durban.

GARRATT, P.A.; (1985) - The offshore line fishery of Natal; 1. Exploited population structures of the Sparids *Chrysoblephus puniceus* and *Cheimerius nufar*. Investigational Report No. 62: 1-17. Oceanographic Research Institute, Durban.

GARRATT, P.A.; (1986) - Natal offshore Sparidae, pp. 38-40. *In* Report on research during the period April, 1985 to March, 1986. Oceanographic Research Institute, Durban.

GARRATT, P.A. AND R. VAN DER ELST (1987) - Natal offshore Sparidae, pp. 24-28. *In* Report on research during the period April, 1986 to March, 1987. Oceanographic Research Institute, Durban. (Unpublished Report No. 48).

ISAAC, V.; (1991) - The accuracy of some length-based methods for fish population studies. ICLARM Technical Reports 27: 81 pp.

PAULY, D.; (1978) - A preliminary compilation of fish length growth parameters. Ber. Inst. Meereskd. Christian-Albrechts Univ. Kiel. 55: 200 pp.

PAULY, D.; (1986) - On improving operation and use of the ELEFAN programs. Part II. Improving the estimation of L_{∞}. Fishbyte 4(1): 18-20.

PAULY, D. AND J.L. MUNRO (1984) - Once more on growth comparisons in fish and invertebrates. Fishbyte 2(1): 21.

PAULY, D. AND P. SPARRE (1991) - A note on the development of a new software package, the FAO-ICLARM Stock Assessment Tools (FiSAT). Fishbyte 9(1): 47-49.

SHEPHERD, J.G.; (1987) - A weakly parametric method for estimating growth parameters from length composition data, pp. 113-119. *In* D. Pauly and G.R. Morgan (eds.) *Length-based methods in fisheries research.* ICLARM Conference Proceedings 13: 468 pp.

SMITH, J.L.B. AND M.M. SMITH (1986) - Family No. 183: Sparidae, pp. 580-594. *In* M.M. Smith and P.C. Heemstra (eds.) Smith's sea fishes. Springer Verlag, Berlin.

TIMOCHIN, I.G.; (1988) - Informaço preliminar sobre a pesca à linha nas águas a sul de R.P.M. INF/ SEP No. 1/88. Instituto de Investigaçao Pesqueira, Maputo.

VAN DER ELST; (1981) - A guide to the common sea fishes of southern Africa. C. Struik, Cape Town, 367 pp.

WETHERALL, J.A.; (1986) - A new method for estimating growth parameters from length-frequency data. Fishbyte 1(4): 12-14.